Claims

1. An electronic system, comprising a reader and a remotely powered and remotely interrogated sensor transponder, said sensor transponder including a coil or antenna, a switched reactance circuit, a processor, and a sensor, wherein said sensor can detect more than two values of a parameter, wherein said sensor transponder receives power radiated from said reader for powering said sensor transponder, and further wherein said sensor transponder is capable of processing sensor data in said processor and transmitting said sensor data to said reader using said switched reactance circuit.

2. An electronic system as recited in claim 1, wherein said sensor comprises an analog device.

3. An electronic system as recited in claim 2, wherein said sensor transponder further comprises an analog/digital converter.

4. An electronic system as recited in claim 1, wherein said sensor comprises a digital sensor.

5. An electronic system as recited in claim 1, wherein said switched reactance circuit comprising a reactive component switchably connected to switchably affect electromagnetic radiation radiated from said reader.

6. An electronic system as recited in claim 1, wherein said reader includes a reader coil or antenna for transmitting electromagnetic radiation, wherein said reader comprises a circuit to detect changes in loading of said reader coil or antenna as a result of switching of said switched reactance circuit in said sensor transponder.

7. An electronic system as recited in claim 1, wherein said receiver coil or antenna comprises a tap or capacitive divider for providing power to said sensor or to said controller.

8. An electronic system as recited in claim 7, wherein said receiver coil or antenna comprises multiple taps, wherein tap location is dynamically selected depending on loading to provide impedance matching and efficient energy transfer.

9. An electronic system as recited in claim 1, wherein said receiver coil or antenna and said sensor transponder are located in a metal enclosure and wherein said receiver coil or antenna is tuned to receive radiation at a frequency sufficiently low so a substantial portion of said radiation is able to penetrate through said metal enclosure, there being no feed through passing through said enclosure.

10. An electronic system as recited in claim 9, wherein said frequency is less than 125 kHz.

11. An electronic system as recited in claim 9, wherein said frequency is less than about 44 kHz.

12. An electronic system as recited in claim 9, wherein said frequency of about 4 kHz.

13. An electronic system as recited in claim 1, wherein said sensor transponder is hermetically sealed.

14. An electronic system as recited in claim 13, wherein said sensor transponder is for implanting in living tissue.

15. An electronic system as recited in claim 14, wherein said sensor transponder is for

implanting in a bone.

16. An electronic system as recited in claim 1, wherein said processor includes an integrated clock.

17. An electronic device as recited in claim 16, wherein said integrated clock comprises an RC clock.

18. An electronic system as recited in claim 1, wherein said sensor transponder further includes a non-volatile memory for storing sensor data.

19. An electronic system as recited in claim 1, wherein said sensor transponder further includes an energy storage device.

20. An electronic system as recited in claim 1, wherein said energy storage device is connected to provide a higher power to said sensor than is available from said coil or antenna.

21. An electronic device, comprising a receiver resonant tank circuit having a switched reactance circuit and a power-using device, said receiver resonant tank circuit for receiving electromagnetic radiation for powering said power-using device, said switched reactance circuit for facilitating external communication, said receiver resonant tank circuit comprising a receiver coil or antenna, wherein said receiver coil or antenna includes a first end and a second end, wherein said receiver resonant tank circuit further includes an impedance matching circuit, wherein said impedance matching circuit is connected to said receiver coil or antenna to provide greater current to said power-using device than would be available to said power-using device if said power-using device were connected between said first and said second end.

22. An electronic device as recited in claim 21, wherein said impedance matching circuit comprises a tap between said first and said second end.

23. An electronic device as recited in claim 22, wherein said tap is provided at a location between said first end and said second end so said power-using device does not substantially degrade Q factor of said receiver resonant tank circuit.

24. An electronic device as recited in claim 21, wherein said impedance matching circuit comprises a plurality of taps between said first and said second end, wherein connection is switchably provided to one of said plurality of taps to most closely impedance match to impedance of said power using device.

25. An electronic device as recited in claim 21, wherein said impedance matching circuit comprises a capacitive divider.

26. An electronic device as recited in claim 25, wherein said capacitive divider provides an output set so said power-using device does not substantially degrade Q factor of said receiver resonant tank circuit.

27. An electronic device as recited in claim 21, wherein said impedance matching circuit provides an output so impedance of said power-using device approximately matches impedance presented by said coil or said antenna at said output.

28. An electronic device as recited in claim 21, wherein said impedance matching circuit provides an output so power transfer to said receiver resonant tank circuit from said electromagnetic radiation is not substantially degraded for expected power consumption of said power-using device.

29. An electronic device as recited in claim 21, wherein said impedance matching circuit provides an output so power transfer to said power-using device from said receiver resonant tank circuit is optimized for expected power consumption of said power-using device.

30. An electronic device as recited in claim 21, further comprising a processor, wherein said impedance matching circuit has an output that can be dynamically varied during operation under the control of said processor, so power transfer to said receiver resonant tank circuit from said electromagnetic radiation is optimized for power actually being consumed by said power-using device and so power transfer to said power-using device from said receiver resonant tank circuit is optimized for expected power consumption of said power-using device.

31. An electronic device as recited in claim 21, wherein said power-using device comprises a sensor, an actuator, or a rechargeable energy storage device.

32. An electronic device as recited in claim 21, wherein said power-using device further comprises a microprocessor, control electronics, or memory.

33. An electronic device as recited in claim 21, wherein said switched reactance circuit

comprises a component switchably connected to said receiver resonant tank circuit for modifying resonant frequency of said receiver resonant tank circuit.

34. An electronic device as recited in claim 33, wherein said component comprises a capacitor or an inductor.

35. An electronic device as recited in claim 21, further comprising a reader comprising a reader coil or a reader antenna for transmitting said electromagnetic radiation, wherein said reader comprises a circuit for detecting changes in loading provided by said switched reactance circuit.

36. An electronic device as recited in claim 21, further comprising a reader comprising an rf receiver, wherein said power-using device comprises an rf transmitter for transmitting data to said reader.

37. An electronic device for powering a load, comprising a receiver coil or antenna, an impedance matching circuit, and a controller, wherein said receiver coil or antenna includes a first end and a second end, further wherein said impedance matching circuit is connected to said receiver coil or antenna to provide greater current to said load than would be available to said load if said load were connected between said first end and said second end, and wherein said controller adjusts said impedance matching circuit to provide dynamic impedance matching to said load.

38. An electronic device as recited in claim 37, wherein said impedance matching circuit comprises a plurality of taps to said receiver coil or antenna and a switch for connecting one of said taps to said load, wherein said controller detects impedance of said load and selects switch position to provide said dynamic impedance matching.

39. An electronic device as recited in claim 37, wherein said impedance matching circuit comprises a capacitive divider circuit, wherein said controller detects impedance of said load and adjusts said capacitive divider circuit to provide said dynamic impedance matching.

40. An electronic device as recited in claim 37, wherein said load comprises a sensor.

41. An electronic system, comprising a reader and a remotely powered and remotely interrogated sensor transponder, said sensor transponder including a receiver coil or antenna, a switched reactance circuit, a processor, and an energy storage device.

42. An electronic system, comprising a reader and a remotely powered and remotely interrogated sensor transponder, said sensor transponder including a sensor and a receiver coil or antenna, wherein data from said sensor is conditioned to provide sensor data ratiometric with magnitude of excitation voltage provided by said receiver coil or antenna.

43. An electronic system as recited in claim 42, wherein said receiver coil or antenna includes a tap, wherein said sensor transponder is connected to receive power from said tap, and wherein said excitation voltage is voltage at said tap.

44. An electronic system as recited in claim 42, wherein said data is transmitted by a switched reactance circuit or by a transmitter.

45. An electronic system, comprising a reader and a remotely powered and remotely interrogated sensor transponder, said sensor transponder including a plurality of networked switched reactance devices connected to a single receiver coil or antenna, wherein each said sensor transponder receives power from said reader, wherein each switched reactance device has an address and wherein each switched reactance device has a system to transmit data so as to avoid collisions.

46. An electronic system as recited in claim 45, wherein said system to avoid collisions includes a random timing generator.

47. An electronic system as recited in claim 45, wherein each of said plurality of networked switched reactance devices includes data logging.

48. An electronic system as recited in claim 45, wherein each of said plurality of networked switched reactance devices includes energy storage.

49. An electronic system as recited in claim 45, wherein each of said plurality of networked switched reactance devices includes two way communication.

50. A sensing system for sensing a parameter related to a living body, comprising a comprising a reader and a remotely powered hermetically sealed transponder for implanting in the living body, said transponder including a coil or antenna, a switched reactance circuit, a processor, and a sensor or actuator, wherein said transponder receives power radiated from said reader for powering said sensor or actuator, and further wherein said transponder is capable of receiving data from said reader or transmitting data to said reader using said switched reactance circuit.

51. A sensing system as recited in claim 50, wherein said transponder is part of a medical implant.

52. A sensing system as recited in claim 51, wherein said transponder is part of an orthopedic implant.

53. A sensing system as recited in claim 50, further comprising a housing facing said transponder, wherein said transponder senses position with respect to said housing.

54. A sensing system as recited in claim 50, wherein said sensor comprises a displacement sensor, a pressure sensor, a force sensor, a torque sensor, or a temperature sensor.

55. A sensing system as recited in claim 54, wherein said displacement sensor comprises a variable reluctance transducer.

56. A sensing system for sensing corrosion of a member, comprising a comprising a reader, a remotely powered sensing transponder, and a member subject to corrosion, said transponder including a coil or antenna, a switched reactance circuit, a processor, and a sensor, wherein said transponder receives power radiated from said reader for powering said sensor, wherein said sensor is located to detect corrosion of said member, and further wherein said transponder is capable of transmitting sensor data to said reader using said switched reactance circuit.

57. A sensing system as recited in claim 56, wherein said apparatus for reporting sensor data can report a change in said sensor data or can report sensor data within an acceptable limit.

58. An electronic device, comprising a metal container having no feed-through, said metal container holding a circuit, said circuit including a power using element and a radiation receiving element, said radiation receiving element for receiving electromagnetic radiation that penetrates into said metal container for powering said power-using element, said radiation receiving element tuned to receive radiation having a frequency low enough to substantially penetrate into said metal container.

59. An electronic device as recited in claim 58, wherein said metal container is hermetically sealed.

60. An electronic device as recited in claim 58, wherein said circuit within said metal container receives all its power from said radiation.

61. An electronic device as recited in claim 58, wherein said metal container includes no energy storage device.

62. An electronic device as recited in claim 58, wherein said metal container includes an energy storage device, wherein said energy storage device is connected for recharging from energy received from said radiation that penetrates into said container.

63. An electronic device as recited in claim 58, wherein said radiation receiving element comprises a tank circuit.

64. An electronic device as recited in claim 63, wherein said tank circuit includes a receiver coil and a first capacitor, said tank circuit further including a second capacitor and a switch, wherein said switch is configured to switchably include said second capacitor in said tank circuit along with said receiver coil and said first capacitor.

65. An electronic device as recited in claim 58, wherein said power using element comprises a sensor.

66. An electronic device as recited in claim 58, wherein said circuit includes a switched reactance transponder for communicating data from said power using element.

67. An electronic device as recited in claim 66, wherein said radiation receiving element comprises a tank circuit, wherein said tank circuit includes a receiver coil, a first capacitor, a second capacitor, and a switch, wherein said switch is configured to switchably include said second capacitor in said tank circuit or exclude said second capacitor from said tank circuit for communicating said data.

68. An electronic device as recited in claim 58, wherein said receiver coil has a circuit for providing a lower impedance output than said receiver coil as a whole.

69. An electronic device as recited in claim 68, wherein said circuit for providing a lower impedance output comprises a tap or a capacitive divider.

70. An electronic device as recited in claim 58, wherein said circuit for providing a lower impedance output is for providing high current to said power using element while maintaining high Q for the receiver coil.